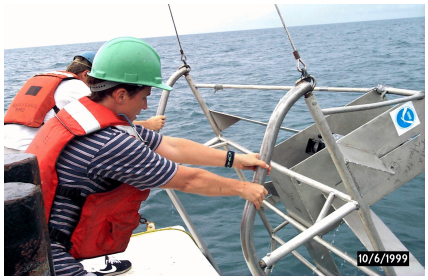
*A*PPLIED *S*PATIAL *E*COLOGY and *H*ABITAT *C*HARACTERIZATION TEAM

NOAA, NOS, Center for Coastal Fisheries and Habitat Research BEAUFORT LABORATORY

Keywords: spatial analysis, remote sensing, semivariogram, fractals, seagrass, coral, habitat, Geographic Information Systems, towed video, mapping, characterization, restoration.

Overview: We conduct applied research, supported by basic scientific investigations, on the spatial organization and characteristics of NOAA trust resources. We focus on spatial ecology applications as a means to conduct habitat characterization at many scales. We use an integrated approach including not only the spatial pattern of benthic features but their morphological, functional, and basic biological attributes. The approach utilizes a range of data collection techniques, ranging from a remotely sensed perspective using satellite and aircraft platforms, underwater towed and remotely operated video, and SONAR to a biological perspective employing *in situ* manual census. All work is geographically referenced, typically through use of survey grade DGPS. Spatial assessments routinely utilizes semivariograms, fractal analysis and krigging to assess seafloor patterns and perform data interpolations. Applications of this work include: 1) basic geographic descriptions of the temporal and spatial attributes of trust resources, 2) improvements in sampling procedures, 3) developing habitat classification protocols, 4) comprehension of the role various marine habitats play in the coastal ecosystem, 5) planning of restoration projects, and 6) forecasting change in trust resources from both natural, extreme events and anthropogenic alterations.



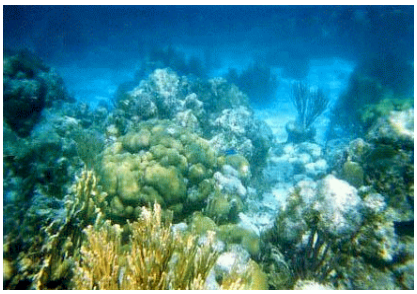
Retrieving benthic video sled onto the NOAA ship FERREL on the West Florida Shelf.

Results of these studies are transferred to federal and state natural resource managers to aid in the proper delineation, understanding, conservation and restoration of coastal habitats. Staff members conduct research throughout the United States, and collaborate with academic institutions, government agencies, and other scientists around the world.

Research Program: We are conducting monitoring and research on a number of fronts: 1) Ecological Characterization of the Dry Tortugas proposed Ecological Reserve to determine: a) What is the effect of creating this Ecological Reserve?, and b) What is the role of these Reserves as Marine Protected Areas (i.e. downstream effects); 2) Determination of the Ecological Boundaries of the coral reef ecosystem in La Parguera, Puerto Rico, and 3) Investigations of the deepwater seagrass / algae / hardbottom resources of the west Florida shelf. We are conducting detailed spatial assessments of the seafloor in these areas to guide sampling strategy and assess the status and distribution of these habitats. Over 500 km of seafloor transects will have been evaluated by the close of these projects.

Below is a description of several of our current projects.

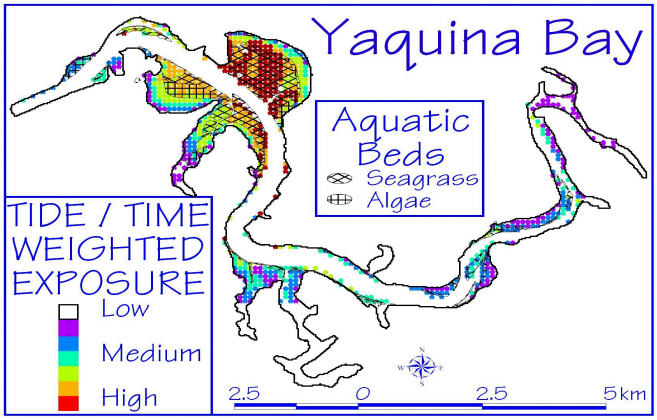
Dry Tortugas Ecological Reserve and the West Florida Shelf: We are conducting multiple cruises aboard NOAA research vessels to investigate the effects of human disturbance (i.e., elimination of consumptive sampling and physical impacts) on the functioning of coral reef and deepwater algal and seagrass ecosystems, as well defining the ecological (as opposed to simply the physical boundaries) boundaries of the Dry Tortugas coral reef ecosystem. Extensive mapping of the seafloor, both in terms of community type, relief and spatial position has been achieved over ~ 300 km of the seafloor. Detailed spatial maps are being generated to assess the influence of instituting protected areas and fishing gear impacts.


Coral reef ecosystem of the proposed Ecological Reserve at the Dry Tortugas

Concurrent with spatial examinations, we are conducting a concurrent ecological examination of the fishery resource value of the *Halophila* resource in the Gulf of Mexico aboard NOAA research vessels in collaboration with other CCFHR Teams. Under this initiative, we will expand our study area from the west Florida shelf into the FKNMS, particularly in the area of the Dry Tortugas, determine the geographic extent, locate the offshore depth limit of the resource and describe the linkage of this habitat with hard bottom/coral reef environments in the vicinity. By coupling our seafloor assessment over ~200 km of this area with biological assessments, our results support the hypothesis that benthic primary production provides the base for the food web on this portion of the West Florida Shelf. By conducting detailed spatial analysis of the resource, this provides the basis for forecasting the energetic requirements of living marine resources historically associated with the hardbottom communities

and thus, the ecological boundaries of these habitats, as opposed to simply their physical arrangement in space.

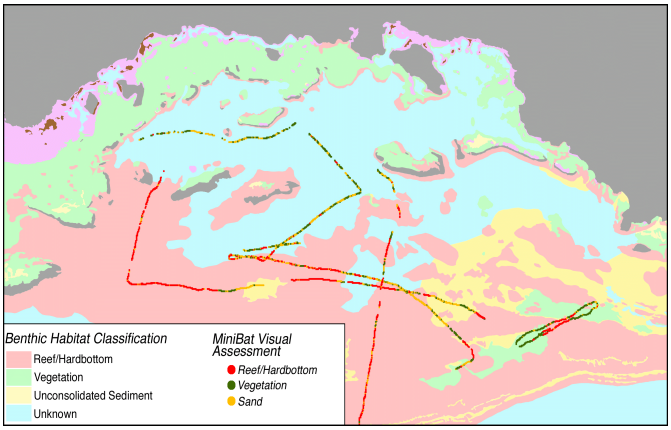
Forecasting Wave Exposure in Seagrass Ecosystems: We have developed a spatial model that incorporates the environmental factors that may influence the development and maintenance of seagrass landscapes. This model provides a parsimonious vehicle that will enable researchers to both hindcast and forecast trends in seagrass landscape structure and function. Our goal is to produce products that predict: 1) the probability of seagrass habitat cover; 2) the probability of seagrass habitat lost to acute storm



Relative wave exposure and tidal emersion model output showing the high predictive capability for seagrass distribution in the Yaquina Estuary, Oregon.

events; and 3) probable sites for regrowth given some level of disturbance (*e.g.* restoration). Each of these products contains explicit information required for managers that could not be derived from a traditional mapped product. With this analytical tool we can now begin to predict the kind of seagrass habitats that may develop in the area as the result of restoration. These predictions extend to the faunal components of the beds. Through hindcasting of storm event data, the susceptibility of these beds (both natural and restored, and the shoreline property they protect) to storm events can be quantitatively forecast.

Ecological Boundaries of Coral Reef Ecosystems: The objective of this work is to support CCMA classification of coral reefs at risk in Puerto Rico by determining the ecological, as opposed to the physical boundaries of the reef. By delineating the ecological requirements of the reef community (i.e., how much energy is derived from both within and outside the reef boundary) we will be able to assess the risk to reef fauna and flora as the result of local alterations in habitat quality. We have classified over 30 km of the seafloor and performed comparative analysis with the less detailed, aerial assessments of the resource in support of this work. Results indicate that characterization based on aerial photography was overall, quite good. However, the in situ sampling using a Minibat® - mounted camera provided a finer grain assessment of the resource and extended the characterization into extensive areas that could not be identified from the aerial photographs.



Minibat tracks in the La Parguera, Puerto Rico area as compared with classified aerial photography.

Effects of Sampling Scale on Submersed Habitat Delineation: Traditional, *in situ* studies of seagrasses and corals have often taken place at a very detailed, 1m scale. Conversely, efforts to quantify the areal extent of these habitats are usually conducted with remote sensing technologies with resolutions that often cannot match this level of detail. We are conducting research that compares remotely sensed data (scanned aerial photos) with 1m scale in situ data to determine if the remotely sensed data can capture the relevant features of a seagrass landscape. The research is taking place in an area of Core Sound, North Carolina that encompasses a gradient of seagrass bed types and has a long history of detailed in situ studies that can be used as reference data. Preliminary results indicate that high resolution (1 m) characterization of these habitats from digitally scanned aerial photography may yield both higher errors of omission and comission than scans at coarser grain (e.g., 10 m resolution), particularly in fragmented habitats. These studies are critical for users to infer what ecological processes, if any, can be inferred from remotely sensed data, and how this may change with improvements in remote sensing technology that are happening at an accelerated pace.

Aerial photo of seagrass beds in Core Sound, North Carolina - 1:20000 true color photography.

ASEHC STAFF: Donald Field, Mark Fonseca (Team Leader), Amy Uhrin, Lisa Wood